# Biologically Inspired Learning

## Spiking Neural Networks

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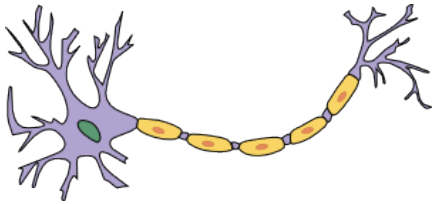
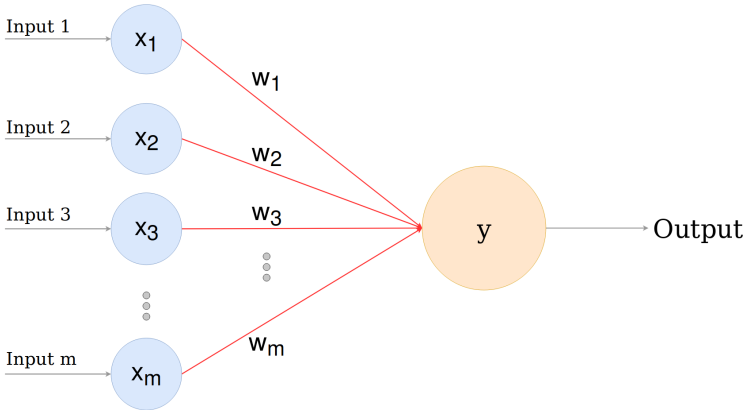
# Spikes

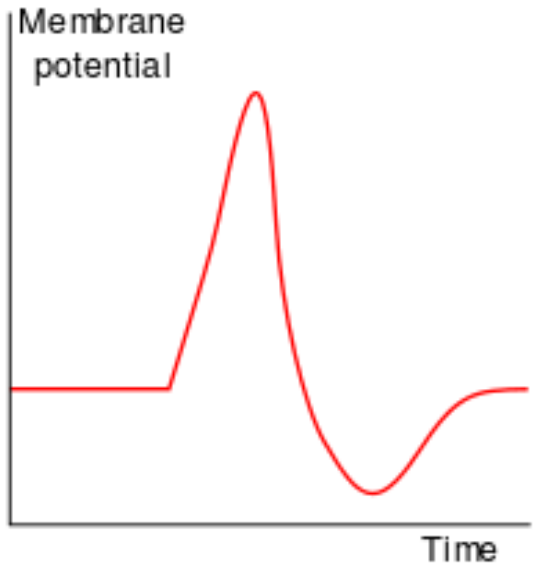
## Neuron



## Perceptron




## Action Potential



# Activation Functions

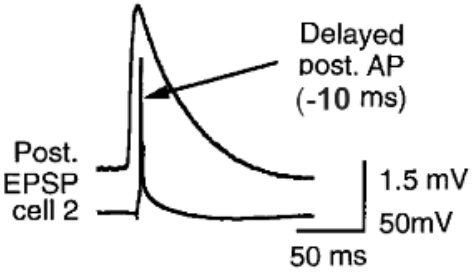
Membrane Potential - LIF

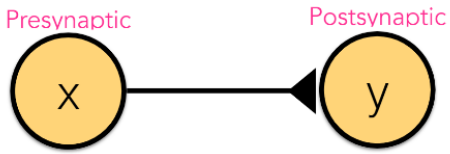
$$\tau \frac{dV(t)}{dt} = -V(t) + R_m I_{stim}(t) + R_m I_{syn}(t)$$

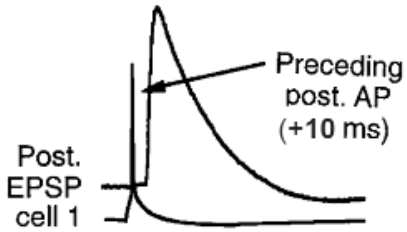
$$if\ V(t) > V_{thresh}\ then\ spike$$

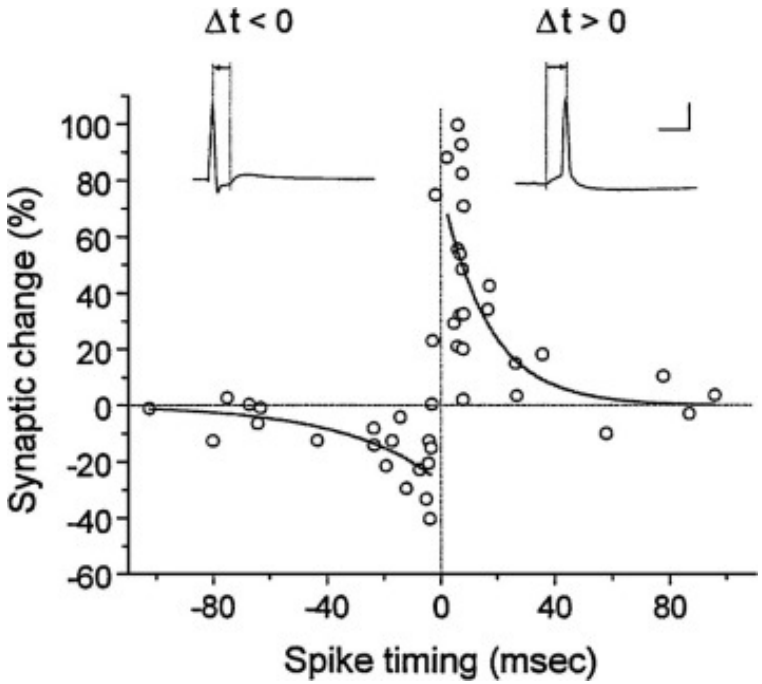
- A model of membrane potential
- Leaky Integrate and Fire (LIF)
- Spike Response Model (SRM)

# Spike Time Dependent Plasticity



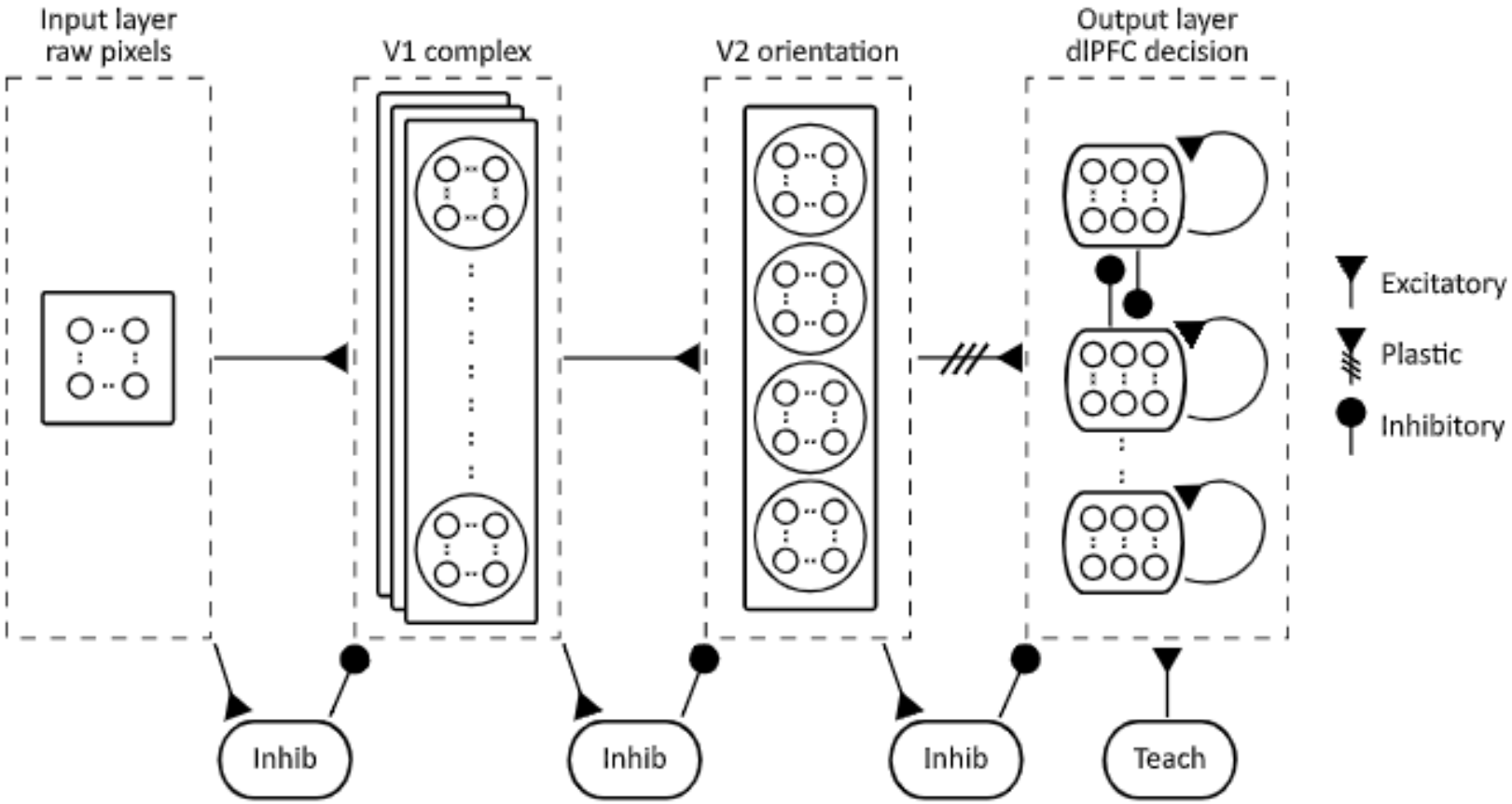



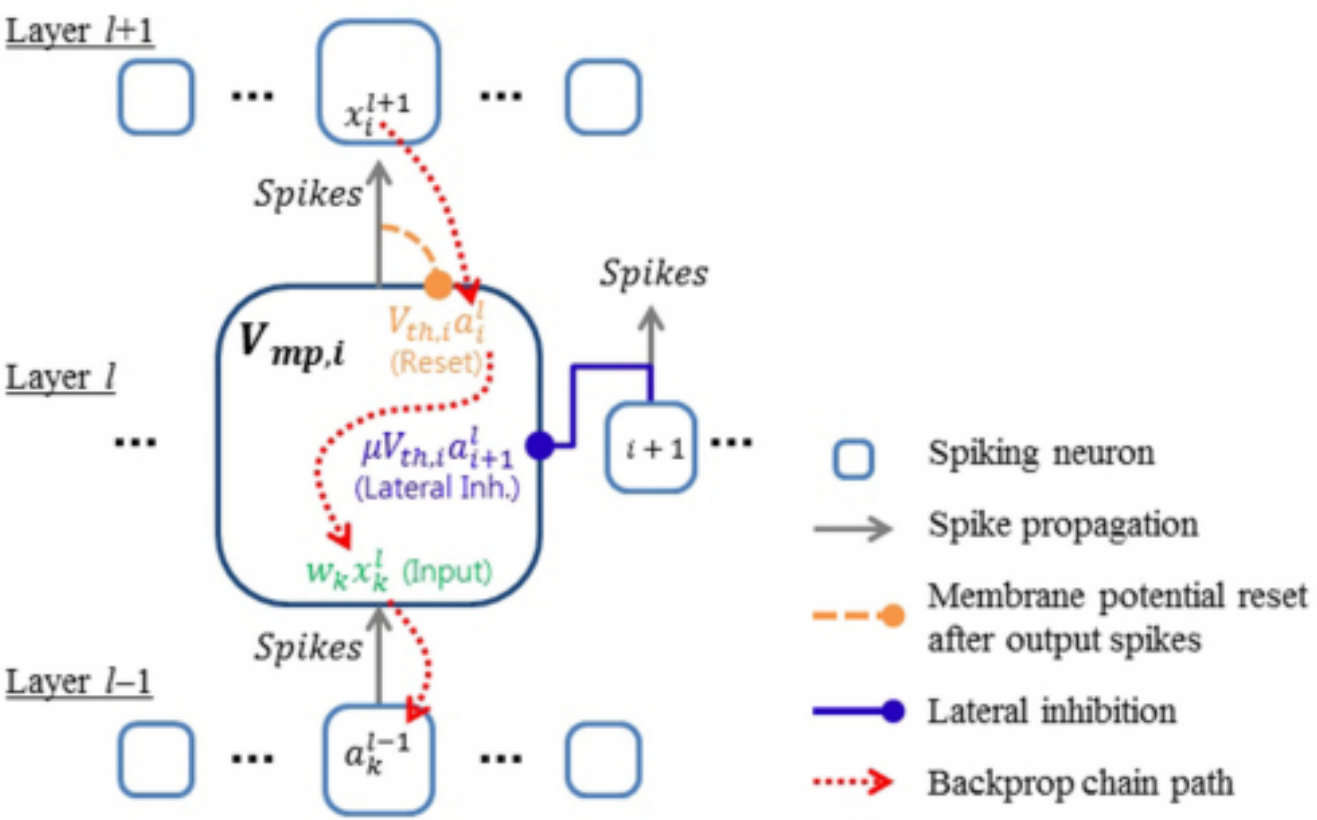

Markram et al. 1997

# Deep Spiking Networks




M. Beyeler et al. 2013

# Back to Backprop




Lee et al. 2016

# Final Points

- Spiking Networks are approaching traditional networks in performance
- We are still working out how to train them
- Spiking Networks have many advantages